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ABSTRACT

Although curriculum development ideas suggested by Doctor of Philosophy and Master's students have received little attention in the curriculum literature, they have existed for some time and have been gaining momentum. In Israel, a high proportion of the science education dissertations has involved curriculum development. A review of curriculum development dissertations worldwide has identified the following types: (1) new topics for university-level education; (2) new topics for high school; (3) innovative instructional strategies; (4) combination of new topics and new strategies; (5) teaching difficult concepts; (6) teaching special student populations; and (7) identifying and overcoming student misconceptions. A review of 104 Doctor of Philosophy and 56 Master's dissertations indicates that, in Israel, most dissertations belong to types 3, 4, and 5. Despite some limitations in scope, curriculum development dissertations were found to have considerable merit, including the review and assessment process that guarantees quality control. These dissertations can be an inexpensive way of producing innovation and stimulating further research. Products of these dissertations have a relatively high potential for actual use. One table lists dissertation distribution frequency. (SLD)

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INTEGRATING RESEARCH AND DEVELOPMENT:
CURRICULUM DEVELOPMENT DISSERTATIONS

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INTEGRATING RESEARCH AND DEVELOPMENT: curriculum development dissertations

Prior to the curriculum reform of the 1960's most curriculum materials were prepared by single authors and the student textbook had been the exclusive form used by curriculum authors. Since the 1960's the principle of team work and deliberation among subject matter specialists, teachers and other experts such as philosophers, psychologists and sociologists became the dominant model in the curriculum literature (Tyler, 1949; Grobman, 1969; Schwab, 1978). However, in practice, a variety of "naturalistic" curriculum development models have emerged (e. g. Walker & Schaffarzic, 1974).

Curriculum development by Ph.D. and Master's students has hardly received any attention in the curriculum literature, but has had, nevertheless, been around for quite some time and has been gaining momentum especially in science and mathematics education in several countries. Such dissertations are designated as "curriculum development dissertations". To qualify as a "curriculum development dissertation" the thesis should include actual development of at least one unit of curriculum materials.

A very high proportion of the science dissertations in Israel have involved curriculum development. How can this situation

be explained? Perhaps a brief review of curriculum development in Israel will have the clue.

Until the early 1960's curriculum development was totally left to individual authors, often Ministry inspectors. The ministry of Education prescribed the syllabus as well as the requirements for the matriculation examinations, and these specifications served as blue print for textbook writers. In the early 1960's, following the curriculum reform in the U.S.A. and in the U.K., a number of curriculum development projects in science were established in the two leading institutions of higher education, namely, the Hebrew University and the Weizmann Institute of Science. These projects were initiated and directed by leading scientists who recruited experienced teachers and Ministry inspectors as collaborators. While enthusiasm was high and the needs for courses' improvement were very urgent, expertise in modern approaches to curriculum development was practically nil. Hence, most of the high school programs in that early period were adaptations of programs developed in the U.S. and to some extent in the U.K. However, it was quickly realized that in the long run, in order to better meet the local needs, future curriculum development would have to be done locally and, hence, there was a great need for people who would gain expertise in curriculum development as well as in other aspects of science and mathematics education.

As a result of this realization two science teaching departments, one at the Hebrew University and the other at the Weizmann Institute of Science were founded in the late 1960's. These departments were designed to achieve two main goals: (a) to promote research in science education, and (b) to train researchers and leaders in the field of science education. Many of the scientists who volunteered their services to the work of curriculum development found themselves in the position of dissertation supervisors. Naturally, this kind of supervisors in such a milieu would favor dissertation topics which were closely related to the problems they had to struggle with in their everyday work in curriculum development.

Typical examples of such topics are: "The teaching of biology in mixed ability classes", "A field study unit on desert ecology", "A curriculum on human biology for grades 7 to 9", "A human biology module using a holistic approach", "Substituting laboratory work in chemistry by filmed experiments", "A geo-chemistry curriculum for high school students".

Later on in the mid-1970's a "new" generation of supervisors has emerged. While the first generation consisted of supervisors whose own research was in science, the new generation brought into the scene professional science educators, namely persons with Ph.D. degrees in science education whose own research was done in science education.

Although close contact with curriculum development was maintained, the nature of the supervised dissertations has changed, as described below.

Two major varieties may be identified. In the first, a unit is developed in such a way that it provides opportunity to test an innovative instructional approach. For example: "Teaching microbiology with the help of the concept mapping" or "A teaching game for elementary chemistry" or "A new program on special theory of relativity", or "Hormonal communication: an integrated biology chemistry unit", or "Teaching evolution by historical approach".

In the second, the dissertation consists of two parts. The student begins by an analytical-diagnostic study of a certain issue, e.g. "learning difficulties in the laboratory" or "the ability to distinguish between teleological and causal explanations". Having identified a problem, or a set of problems, special remedial curriculum units are then developed, tried and evaluated to find out to what extent had the remedy been successful. Thus, for the two issues identified above, the following units were developed, respectively: "Basic concepts in scientific research" and "A lesson sequence teaching high school students to distinguish between causal and teleological explanations". The "new" generation of dissertations often incorporates ideas and concepts borrowed from the history and philosophy of science.

Topics and issues featured by curriculum development dissertations

World wide the following types of curriculum development dissertations were identified (Tamir, 1984):

1. A new topic developed for the university level. For example: "An innovative environmental science education program for secondary school science teachers", or "The microcomputer in high school science laboratory - a short course for teachers".
2. A new topic developed for the high school level. For example: "Physics in medical diagnosis: a new physics unit for high school", or "Hormonal communication: development and implementation of an integrated biology-chemistry unit".
3. An innovative instructional strategy. For example: "A creativity oriented physics curriculum for secondary schools", or "Teaching microbiology with the aid of concept mapping", or "Using filmed experiments as a substitute for laboratory work in high school chemistry".
4. Combination of new topic and new strategy. For example: "A unit on plant identification for individualized learning", or "Teaching colorimetric methods by the audio-tutorial approach", or "The design and evaluation of a field study unit on desert ecology".

5. Teaching difficult concepts. For example:
"The development and evaluation of a unit on basic concepts of scientific research", or
"The development and evaluation of a lesson sequence to teach high school students to distinguish between causal and teleological explanations", or
"Development of a new program on special theory of relativity for high school".
6. Teaching special student populations. For example:
"Teaching biology to heterogeneous 7th grade classes", or
"Development implementation and evaluation of a biochemistry curriculum for nursing schools".
7. Finally, there are dissertations which identify students' misconceptions and design activities to overcome the misconceptions without changing the textbook currently in use. The remedial materials may be designed just for teachers, or may include both teacher and student materials which can be incorporated into any regular course. An example is a thesis entitled "The identification of learning difficulties related to the study of photosynthesis, designing remedial materials for the teachers and evaluating the effectiveness of these materials" (Amir, 1991).

Whereas most of the curriculum development dissertation in the U.S.A. cater for the college level (Type 1) the majority of Israeli dissertations belong to types 3, 4 and 5 (Tamir, 1984).

Limitations and merits of curriculum development

dissertations

In many countries curriculum development dissertations are rare. This is probably a result of the unique nature of such dissertations. As already mentioned in the Introduction, modern models of curriculum development stress the importance of team work and deliberation among experts of varied skills. This kind of team work is not compatible with the nature of dissertations which are supposed to be a creation of one person, namely the graduate student. Furthermore, the time period required for development, trials and revision is usually longer than that commonly devoted to dissertations. Consequently the scope of curriculum development within dissertations must be limited. Our experience shows that a unit of up to 5 lessons for a Master's thesis and of no more than 15 lessons for a Ph.D. thesis is all that can be expected if reasonable standards are to be maintained. One way to develop a whole course, say for one year of study, is by the supervisor undertaking the role of coordinator and assigning different portions of the curriculum to different students. I know of only two examples where this had been done. The first is the audio-tutorial science curriculum for grades one and two which was designed by Novak and his students in Cornell between 1967 and 1975 (see Novak 1977, pp. 238-244). The second is the elementary science curriculum developed in Israeli Science Teaching Center at

Tel Aviv university which was based, in part, on findings of two kinds of Ph.D. and Master's dissertations:

- (a) those which identify and analyze students' preconceptions of concepts such as temperature or concentration of solutions, and
- (b) those which design curriculum units based on the findings of the first kind and test their effectiveness in classrooms (see Stavy & Berkowitz 1980).

It may be concluded that any one curriculum development dissertation can either deal with a specific well defined issue, such as identifying a plant with the aid of a key or distinguishing between causal and teleological explanations, or else be part of a series of dissertations which together will constitute a broader curriculum for an entire course.

While the limitations mentioned above, and perhaps others which may exist, should be borne in mind, the curriculum development dissertation was found to have considerable merits, some of which are listed below:

- (a) It is closely supervised and assessed by a number of independent experts, a procedure which guarantees quality control.
- (b) The product of the dissertation is not "shelved" like in many other kinds of dissertation, but instead, is readily applied and makes a direct contribution to the educational practice. This feature also makes the

graduate students feel good about the usefulness of their efforts.

- (c) In countries where budgets are tight and expertise scarce, curriculum development dissertations constitute an inexpensive way of producing innovative units as well as making good use of the expertise of the supervisors and other university experts. This is especially true in cases where universities have served as curriculum development centers along with their regular research and instructional functions.
- (d) Units developed within dissertations can often serve for additional research purposes, such as testing the validity of a learning theory, or analyzing students' preconceptions. The dissertations supervised by Novak at Cornell and the examination of the effectiveness of concept mapping and advance organizers by two curriculum development dissertations in Israel (Barenholz, 1990, Rubin & Tamir, 1988) are good examples both pertaining to Ausubel's theory of learning (Ausubel, 1968).

The products of curriculum development dissertations have a relatively high potential of being actually used in educational practice.

Indeed, all the units so developed at the science teaching departments in Israel have been revised on the basis of their formative evaluation and in their revised form are currently being used in schools. That this has usually been the case indicates that curriculum development dissertations are a

viable and useful alternative model for curriculum development and research, especially for units of limited scope featuring innovative approaches and focusing on particular instructional and learning problems.

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Table I

Frequency distribution of Ph.D. and Master's curriculum development dissertation in Israel by type in the year 1970-1990 (in percentages)

Type	Ph.D. N=104	Master's N=56
1 A new topic, university level	2	3
2 A new topic, high school level	41	33
3 An innovative instructional strategy	17	11
4 A combination of new topic and new strategy	12	44
5 Teaching difficult concepts	18	0
6 Teaching special student populations	12	4
7 Identifying and overcoming student misconceptions	10	5
Total	112*	100

*A few topics were included in two types